

Impact Of Pet Bottles Disposals And Management Mechanisms In Selected Urban Cities Of Ghana

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Abstract—The population of Ghana is growing at an alarming rate with its attendant increase in waste generation, specifically PET bottle-waste. Prior studies have shown that, the chemical composition of the materials in making the PET bottles; from exploration of petroleum as raw materials, to the non-biodegradable nature of the empty bottles are an obvious unsustainable practice, and a real menace to the environment. This study seeks to identify i) various sources of empty PET bottles, ii) its social as well as its economic impact on the environment, ii) identify various levels of strategic stakeholders and iv) discuss critical issues relating to a potential establishment of a PET recycling firm in Ghana; with the view of addressing its impact or mitigating its effects.

Keywords—waste management; PET bottles; Ghana; Recycling

I. INTRODUCTION

The exponential growth in economic activity in recent times has led to an intense upsurge in waste production, making the generation of solid waste a major environmental problem, predominately in the Western world [7]. However, the situation is not different in developing countries. The economic growth and changing consumption and production patterns are leading to rapid rise in generation of plastic waste in the world [3]. This phenomenon has great negative impact on the environment. One of the crude ways in solving this environmental issue is by burning the generated waste, especially in the case of solid waste. Although, the technique employed in waste burning reduces the volumes of the accumulated waste and allows the recovery of some of the resources in the waste as energy, this however results in a negative externality; air pollution [1]. Recently, there has been increasing focus on ways to reduce the amount of waste through sustainable methods. The two main existing potential methods include: (1) recycling of waste products in order to re-use them by other users, for other purposes [6], and (2) preventing the origination of waste by, e.g., using fewer primary materials in production processes and designing products that are recyclable.

Various authors have defined waste differently. According to Boadi [2], waste is any moveable

material that is perceived to be of no further use and that is permanently discarded. In this study, the authors aim at finding the status of solid waste generation, especially PET bottles and their disposal in the major cities of Accra and Tema, and its importance to national socio-economic development.

II. WASTE MANAGEMENT STRATEGIES

In this study, we argue that, waste is a potential wealth creation venture, and managing consciously the waste is the start point to this realization. [4] reported that Waste management is the "generation, prevention, characterization, monitoring, treatment, handling, reuse and residual disposition of solid wastes". There are various types of solid waste, including municipal (residential, institutional, commercial), agricultural, and special (health care, household hazardous wastes, sewage sludge). The term usually relates to materials produced by human activity, and the process is generally undertaken to reduce their effect on health, the environment or aesthetics.

Obviously, plastic waste generation such as PET (**polyethylene terephthalate**) is a major problem because they are non-biodegradable: they can stay in the environment for about 1000 years¹, causing various forms of environmental challenges, translating into acute health conditions in the long run.

For example, plastic is made from petroleum or natural gas in a chemical process that combines smaller molecules into a large chain-like molecule, often with other substances added to give it particular qualities. Typical among them are phthalates and bisphenol A, these chemicals have been found to be hazardous to the living things. Plastic production is estimated to use 8 percent of yearly global oil production—both as the raw material and for energy in the manufacturing process.

Based on this observation, [5] argued that the disposal of plastic wastes in land fill sites is dangerous to the environment and the most sustainable method of managing plastic waste is by recycling. This is because recycling is environmentally friendly, compared to other means of plastic waste disposal.

¹<http://blogs.ei.columbia.edu/2012/01/31/what-happens-to-all-that-plastic/>

Recycling of plastics creates employment and it is of economic importance to the nation. Furthermore, it can serve as a form of raw material to produce other products.

This avenue has created a dynamic and growing market for the long-term recycling strategies, one which virtually thousands of empty PET bottles collected are processed into different wears and other products. Approximately, 20 million of plastic bottles per day are thrown out. Out of the enormous tons generated annually, just few portions are recycled into reusable products. The opportunity here is how to recycle the significant portion of waste PET bottles that are exported from Ghana to other countries for recycling.

Currently, value chain exist in Ghana for empty PETS bottle collection, making the raw materials available and reliable for processing (fig. 3. show a flowchat diagram of PET bottles collection). The plastic wastes generation in Ghana comes from different ways or sources such as

Metropolitan, Municipal, District, Commercial and Industrial waste. The ministry of Local Government and Rural Development (MLGRD) is responsible for managing waste, since it is the government institution that supervises the decentralized the Metropolitan, Municipal and District assemblies (MMDAs). The MMDAs work alongside their private partners such as Zoomlion. With more than ten years of corporate experience in waste collection and management, Zoomlion Ghana Ltd, a leading waste management agency is willing to partner any investor and provide data and guidelines for establishment. The Government of Ghana is also seeking potential investors and provides the enabling environment for waste recycling businesses. Ghana is endowed with great human capital and greater proportions of the population are in their youthful stage making labour readily available. Lastly, due to the presence of inefficient waste recycling systems by the few small scale individual enterprises, lack of credit for waste management and insufficient landfilled points, efforts by a prospective investor to establish a recycling plant would make the value chain complete. Clearly, plastics are very long-lived products that could hypothetically have survived over decades and yet our core use of these lightweight, inexpensive materials, as single-use items that will go to the garbage dump within a year, where they might persist for centuries. Evidential reports indicates that, the chemical building blocks that make plastics so adaptable are the same components that might harm people and the environment. Studies have shown that, its creation and discarding contribute significantly to a number of environmental problems as well. For instance, ¹ chemicals added to plastics are absorbed by human bodies. Some of these compounds have been found to alter hormones or have other potential human health effects. ² Plastic debris, laced with chemicals and often ingested by marine animals, can injure or poison wildlife. ³ Floating plastic wastes, which can survive for thousands of years in water, serves as mini

transportation devices for invasive species, disrupting habitats. ⁴ Plastic buried deep in landfills can leach harmful chemicals that spread into groundwater. ⁵ Approximately, four (4) of world oil production is used as a feedstock to make plastics, and a similar amount is consumed as energy in the process. People are exposed to chemicals from plastic multiple times per day through the air, dust, water, food and use of consumer products. For example, phthalates are used as plasticizers in the manufacture of vinyl flooring and wall coverings, food packaging and medical devices. Eight out of every ten babies, and nearly all adults, have measurable levels of phthalates in their bodies.

III. OBJECTIVES OF THE STUDY

Generally, this paper aimed at providing the status of PET bottles waste in selected cities in Ghana. The specific aims include the following: To identify quantities of PET bottles waste generated in Accra and Tema; to identify how PET bottles waste are currently managed; to provide information on stakeholders in the management of empty PET bottles waste; and to provide an entry strategy for adoption.

IV. AN OVERVIEW OF THE STUDY AREA

Ghana is located in West Africa on the Guinea Coast. At latitudes of 4-12°N, It shares borders with Togo on the East, Burkina Faso on the North, La Cote d'Ivoire on the West and the Gulf of Guinea to the South. Ghana covers an area of 238,539 square kilometers. Ghana is a nation with a population of about twenty five and thirty seven (25.37) million people in 2012 (figure 1). Religions ;Christian 71.2%, Muslim 17.6%, traditional 5.2%, other 0.8%, none 5.2%.Major languages include Asante, Ewe, Dagomba, Ga and others. The official language is English. Accra is its administrative capital, chosen by our colonial masters; Britain, and serves as an economic and cultural center with a population of about two (2) million people. Accra covers about sixty five (65) square miles (figure 2). It was founded by the Ga's in the sixteenth (16th) century as a fishing village. Accra is made up of five (5) administrative districts namely, Accra Metropolitan Assembly, Ga, Tema, Dangme West and Dangme East. In recent times, urbanization and the current growth in population have had diverse negative implications on the environment.

Similarly, Tema is a coastal city, situated about 25km East of Accra, it has a land area of 368.3 square kilometers and an estimated population of 0.6 million people. From the 1960s through 1980s. Rapid transformation of Tema from a small fishing village into an industrial nerve center of Ghana's economy has exposed the city to many environmental challenges. With a deep seaport, Tema handles about 70% of all shipment to Ghana and some land locked countries in the West African Sub-Region. Tema accommodates over 200 small, Medium and large industries include an aluminum smelter, an oil refinery, and food processing plants. Its status as a

Tema Municipal Assembly of the five municipal authorities of the Greater Accra Region, can be divided into urban, and a small rural population occupying a rather larger geographical area. The provision of social amenities have followed the urban (sub-urban) rural dichotomy. While the urban area has organized solid waste collection services,

uninterrupted electricity, pipe borne water supply, a central sewerage system and a fairly good network of roads and drains, the sub-urban and their rural neighbors are not that faced with critical issues of environmental concern.

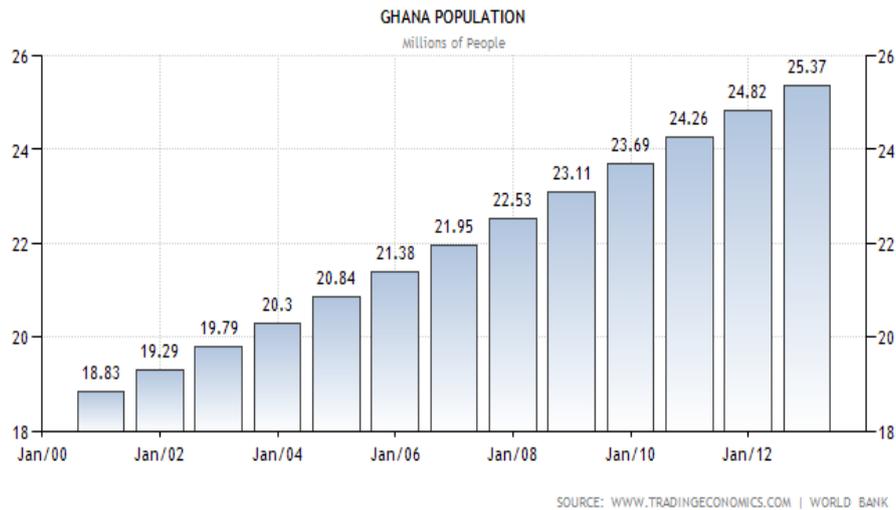
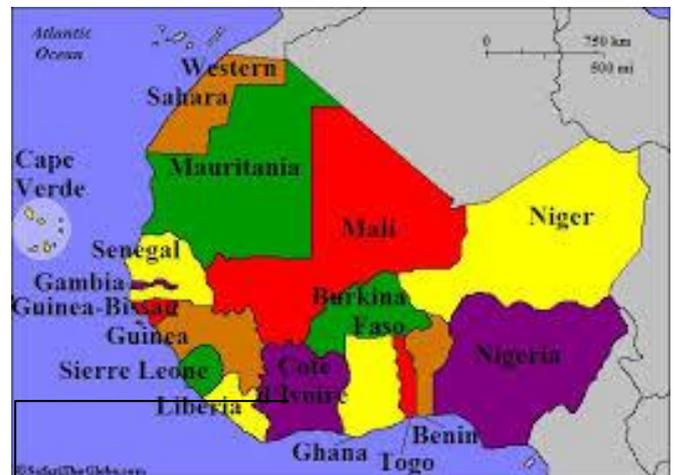


Figure 1: Population trend in Ghana



Map of West Africa

Figure 2: above shows the map of Ghana and the location of Accra, the capital city (marked with red).

Table 1: Estimated Municipal Solid Waste Data for 5 Largest Cities across Ghana (but main focus on Accra and Tema) between 2004 and 2010 (ref.)

Characteristics	Accra	Tema	Sekondi-Takoradi	Tamale	Kumasi	All Cities
Population, thousand *	2,340	537	404	272	1,651	5,204
MSW generated, kg/capita/day	0.80	0.70	0.70	0.70	0.80	0.75
MSW generated, tons/day	1,872	276	283	190	1,321	4,042
MSW collected, tons/day	1,498	263	226	124	1,123	3,233
Percent collected	75%	70%	80%	65%	85%	80%
Collections cost, US \$/ton	10.0	8.0	7.0	6.0	8.0	7.8
Disposal cost, US\$/ton	3.0	1.5	2.0	2.0	2.0	2.1
Total cost, US \$/ton	13.0	9.5	9.0	8.0	10.0	10

Table 2: Quantity of PET bottle waste generated daily

City	Regional Location	Distance from the Tema and Takoradi ports
Accra	Greater Accra	(33 m) and 220 Km respectively
Tema	Greater Accra	NA and 250 Km respectively
Cape coast	Central Region	144 and 79 Km respectively
Winneba	Central Region	89 m and 166 Km respectively
Takoradi	Western Region	245Km and N/A respectively
Ashiaman	Greater Accra	8km and Km respectively

V. PROPOSED STRATEGIES AND PROCEDURES FOR IMPLEMENTATION

Figure 3 illustrates the channel of empty PET bottle disposal and collection in Ghana. In this regard, people are engaged in the collection of plastic bottles from various sources mainly to reuse them for other purposes. Some of the people scavenge the neighborhoods for the empty plastic bottles, while other street sweepers also supply plastic bottles to 'Qualiba' men. From our observations, we noticed that the plastic bottles are mainly sold at local markets; thus for packaging both local drinks and oil for retail businesses.



Figure 3: Flow chart of plastic empty PET bottle disposal and collection in Ghana

A. Competition and Partnership Organizations

Table 4: Exciting companies in plastic bottles collection and recycling

Companies and year of establishment	Cities companies are located	Contacts	Collection/recycling (ton)
Blowplast Recycling (member of GPMA (Ghana Plastic Manufacture Association))	Accra	Blowplast Industries Limited, Graphic Road, South Industrial Area, Behind Areeba Office, Accra.Tel: +233 (21) 223391/ 235124/ 239531; Cell: (233) 24 4315535; Fax: (233) 21 222575; Email: admin@blowgroup.com	(total recycling capacity of minimum 15,000 kilos per day)
The Accra Compost & Recycling Plant (ACARP) Jekora Ventures Universal Plastics Products Recycling	Accra		Exports about 50 tons of PET a month
Zoomlion Ghana Ltd	Accra	Zoomlion Ghana Limited PMB 117, Madina, Accra, Ghana Phone: +233-244-335139/40 Email: info@zoomlionghana.com Website: www.zoomlionghana.com	
Jacmann Recycling Ghana Ltd			collection and processing

B. Prospective Recycling Company in Ghana

In order to reduce the strain on the environment from the deposition of waste in landfills and combustion at incineration plants, several governments throughout the industrialized world have greatly increased recycling of domestic waste by the turn of the millennium. To implement the plans, new waste recycling facilities are to be built and the number of workers involved in waste sorting and recycling will increase steadily during the next decade.

C. The case of BLOWPLAST as model recycling company in Ghana

Terms of Contract

BLOWPLAST is a recycling company located in Ghana, Accra. The Blow Group of Companies was founded in 1993 and it has pursued an unstinted path of growth despite national and international competition. BLOWPLAST GROUP provides full service to virtually every industry in which customized flexible packaging is used: food, pharmaceutical, chemical, textile, airline, railroad, utilities and construction companies, in addition to agricultural, retail, asbestos abatement and medical waste industries. In the plastic recycling component, the company pays the collectors an amount of 400 USD for a week but pay less 20% of the total amount as contamination level, which includes water, sand, etc for cleaning of contaminated materials. BLOWPLAST also provide empty bottle collection companies with garbage transparent bags (28" X 50") to store the plastic waste without any extra cost. With this package, companies have to agree not to supply us with any other garbage waste apart from pure PET empty bottles whether dirty or clean. Again, they will provide a certificate & a credit card with a registration number which will be used for accessing the account number in their system. BLOWPLAST will assemble the waste and weigh it at the dumping site; while the client must guarantee to record the actual weight minus 20% contamination which will be instantly

registered in the client's ledger account. The company will pay clients their cash amounts on weekly or monthly basis as may be preferred.

D. Proposed strategies on how to gain entrance into the recycling business

Through participation in the export trade fair to exhibit the company's activities and its projects, an investor can gain also entrance into the business. Again the prospective investor (PI) can collaborate with the youth employment agency. The youth employment agency is an agency established by the government of Ghana to train, retain and/or distribute trainees to various agencies who need their services. A prospective investor can take advantage of the Government of Ghana's support for foreign investors into the country including the fact that government has harmonized the business registration processes which has significantly reduced time and resources spent on registering businesses in Ghana.

E. Availability of opportunity for collaboration with existing companies

There are opportunities for prospective investor's to collaborate with existing waste collection and recycling companies that are managed by both Government and Private Agencies. For instance, Zoomlion Ghana Limited is the main public-private partnerships (PPPs) agency contracted by the Ministry of Local Government. Zoomlion Ghana Limited has built sustainable relationship with private sector customers (industry, etc), Ministries,

Department and Agencies (MDAs) of the central government, metropolitan, municipal and district Assembly (MMDAs) or local Authorities, and the communities they provide services. Zoomlion also operates in other African countries such as Togo, Angola and Guinea, while negotiations are far advanced for the company to start operations in Nigeria, Sierra Leone and Liberia. In its vision to pursue excellence in the industry, the Zoomlion Ghana Limited has the willingness to exchange ideas with international waste management companies. The photographs below depicts the existing facilities of Zoomlion Ghana Limited to supply raw materials for companies to process, and especially for export (Figure 4)



Figure 4: The photographs below depicts the existing facilities of Zoomlion Ghana Limited to supply raw materials for companies to process.

F. Collaboration with Educational Institutions and Agencies

Education driven economy is one of the key focus of the Government of Ghana and Africa as a whole. The emphasis has been on training individuals with requisite skills to drive the development agenda of government. With this phenomenon, it would be

worthwhile for prospective investors, to partner some universities and/or polytechnics to establish centers for PET recycling studies. Once this collaboration has been realized, it would be a basis for such prospective investor to establish a company that will directly employ graduates of the centre. Secondly, these companies will also serve as facilities for students to have practical and industrial internship experience.

G. Waste separation at source

Solid waste is divided into construction waste and municipal solid waste: while the type of construction waste, including debris (soil, stones, bricks, concrete, slag, etc.), synthetic (plastic, resin, rubber, asphalt, paint, etc.), other (metal, glass, cardboard, wood, etc.). On the other hand, municipal solid waste including natural organic waste (fruits and vegetables, flesh, fur, oil, manure, cotton, flowers, etc.), synthetic organic (plastics, resins, synthetic fabrics, chemicals, etc.), inorganic (metal, stone, glass, etc.), electronics (household appliances, daily-use digital, battery, etc.), special classes (medical waste, dead pet carcasses, chemicals, etc.). Need to go through the garbage after crushing, handling methods include: re-use, anaerobic methane fermentation, pyrolysis, combustion incinerators

However, arrangements could be made with businesses to bring recyclables at their own cost to the sorting facility at the PI collection points that may be located at different parts of the cities. The recyclables are cleaner than what it would have been after collection together with general waste in the collection vehicles. This initial sorting of waste will reduce significantly savings on monthly waste collection bills as well as the losses that occur long the waste collection chain. Therefore, to achieve a sustainable waste recycling system, there must be revolutionary changes; thus the separation of solid waste into at least two streams, is the key to the (figure 3).

The key to the recycling revolution - Separation of solid waste into at least two streams



Figure 3: separation of solid waste into two streams at disposal points

Implications of Sorting of solid waste at final disposal points or landfills

If the waste is sorted before final point of disposal and subsequent recycling, it will reduce the health risk involve. Several studies have emphasized that exposure to airborne microorganisms and the toxic products thereof are important factors causing a multitude of health problems among workers at waste

sorting and recycling plants. For instance, workers at transfer stations, landfills and incineration plants may experience an increased risk of pulmonary disorders and gastrointestinal problems. High concentrations of total airborne dust, bacteria, faecal coliform bacteria and fungal spores have been reported. The concentrations are considered to be sufficiently high to cause adverse health effects. In addition, a high incidence of lower back injuries, probably due to heavy lifting during work, has been reported among workers at landfills and incineration plants. Workers involved in manual sorting of unseparated domestic waste, as well as workers at compost plants experience more or less frequent symptoms of organic dust toxic syndrome (ODTS) (cough, chest-tightness, dyspnoea, influenza-like symptoms such as chills, fever, muscle ache, joint pain, fatigue and headache), gastrointestinal problems such as nausea and diarrhoea, irritation of the skin, eye and mucous membranes of the nose and upper airways, etc. In addition cases of severe occupational pulmonary diseases (asthma, alveolitis, bronchitis) have been reported. Manual sorting of unseparated domestic waste may be associated with exposures to large quantities of airborne bacteria and endotoxin. Several work functions in compost plants can result in very high exposure to airborne fungal spores and thermophilic actinomycetes. At plants sorting separated domestic waste, e.g. the combustible fraction of waste composed of paper, cardboard and plastics, the workers may have an increased risk of gastrointestinal symptoms and irritation of the eyes and skin. At such plants the bioaerosol exposure levels are in general low, but at some work tasks, e.g. manual sorting and work near the balers, exposure levels may occasionally be high enough to be potentially harmful. Workers handling the source-sorted paper or cardboard fraction do not appear to have an elevated risk of occupational health problems related to bioaerosol exposure, and the bioaerosol exposure is generally low

H. Logistics and Land

Estimated cost of land for factory location or establishment in Ghana is \$18,000 per 100*70 feet plot. Availability and cost of labour of similar businesses (\$100 per month)

I. Investment Climate

The economy of Ghana has undergone a remarkable transformation. The economic management program embarked upon in a rather challenging environment of the 80's has re-engineered the Ghanaian economy, which has since registered an average growth rate of 5% per annum. The consistent growth rate of the economy has laid the foundation for social stability and international credibility. The amendments to Ghana's 1985 investment code did open up a wide range of new business opportunities. Followed by the 1994 Ghana Investment Promotion Act guarantees the freedom for non-Ghanaians to establish and run enterprises in potentially lucrative areas such as natural gas, hydropower projects, fruits and

vegetables farming, food processing including fish canning; production of agro-chemicals, pharmaceuticals and information technology. The privatization initiatives by successive governments also opened up a number of sectors for new business partnerships and investment, notably the banking and the state petroleum and telecommunications sectors. Tourism is an especially strong area for a new business projects. Some key opportunities in this sector include: tourist accommodation, particularly beach resorts; tourists transportation, catering enterprises, eco-tourism, night life and leisure and tourist servicing enterprises. Furthermore, renewed private sector activity is increasing and attracting foreign investment in a growing number of strategic areas, notably mining, manufacturing, telecommunications, real estate development and financial services.

The adoption and implementation of sound macroeconomic policies and the enactment of more liberal investment legislations have contributed to the increasing trend of investment recorded over the years. The legislations seek to free the investor from bureaucratic constraints and provide facilitating mechanisms to reduce costs associated with delays in implementing projects. One of such legislation is the Ghana Investment Promotion Centre Act, 1994 (ACT 478), which re-established the Ghana Investment Promotion Centre (GIPC) as an autonomous government agency mandated to encourage, facilitate and promote domestic and foreign investment.

J. Some recommendations for expected steps into the future

1. Regulations for the separation of biodegradable solid waste.
2. Regulations for the separation of paper and cardboard.
3. Amendment to the Maintenance of Cleanliness Law – construction debris.
4. Solid Waste Law: Compilation of all the laws dealing with solid waste.
5. Prohibition of landfilling
6. Updating of solid waste treatment methods
7. Updating of definition of types of solid waste

Appendix

Appendix 1: GHANA FREE ZONES BOARD

The Ghana Free Zones Scheme is an integrated Programme to promote processing and manufacturing of goods through the establishment of Export Processing Zones (EPZs) and encourages the development of commercial and service activities at seaport and airport areas. In essence, the whole of Ghana is accessible to potential investors, who have the opportunity to use the free zones as focal points to produce goods and services for foreign markets. The Ghana Programme is also completely private sector driven. Government's role is limited to the facilitation, regulation and monitoring of the activities of zone developers/operators and enterprises. The Ghana Free Zones Board is the governing body in charge of

issuing licenses to investors who meet the necessary requirements.

K. ACQUIRING OF LICENCES

A company that wants to attain the status of a Free Zone Enterprise has to apply for a license. This application should:

- Be in writing;
- Submitted to the Secretariat of the Board;
- Specify the zone to be developed or managed or both or the trade, business or industry for which the license is required; and
- Be accompanied with such other information as the Board may require.

Generally, a response will be made to your application within twenty-eight (28) working days from the date of the receipt of the application by the Board either approving the application and granting the license or not granting it for reasons such as one not meeting the conditions attached to it.

L. INCENTIVES

The incentives available under the Free Zone status include:

- 100% exemption from payment of direct and indirect duties and levies on all imports for production and exports from free zones.
- For ten (10) years, a free zone developer or enterprise is granted 100% exemption from payment of income tax on profits. Income tax rate is capped at 8% after this ten (10) year period
- Total exemption from payment of withholding taxes from dividends arising out of free zone investments.
- There is also relief from double taxation for foreign investors and employees.
- When it comes to customs and excise obligations, a Free Zones enterprise is not required to obtain import licenses and customs formalities are immersed.
- There are no restrictions on total foreign or local ownership of free zone enclaves and enterprises.
- As regards capital or profit repatriation, there are no conditions or restrictions on:
 - payments for foreign loan servicing;
 - payments of fees and charges for technology transfer agreements;
 - Remittance of proceeds from sale of any interest in a free investment.
- A free zone developer is allowed to operate foreign currency accounts with banks in Ghana.
- A Free Zones enterprise or company is permitted to sell 30% of their annual production of goods and services on the local market and export the remaining 70%.
- Investment in Free Zone is guaranteed against nationalization and expropriation.

M. SETTING UP BUSINESS IN GHANA

PROJECT APPROVAL is NOT required for investment in the economy, except in the following areas:

- Petroleum Business - by Ghana National Petroleum Corporation
- Minerals and Mining Business - by Minerals Commission
- Portfolio Investments - by the Ghana Stock Exchange
- Free Zones Activities - by the Ghana Free Zones Board

N. PROCEDURES

One stop approval and or facilitation by respective Investment promotion Agencies.

O. OWNERSHIP

Joint-Ventures with Ghanaian partners are encouraged BUT 100% foreign participation is allowed.

P. EQUITY

- US\$10,000 for Joint Ventures with Ghanaian partner
- US\$50,000 for 100% Foreign Ownership
- US\$300,000 for Trading Activity

Q. EXPATRIATE EMPLOYMENT

Automatic quotas tied to Investment Capital

- One quota for US\$10,000 - US\$100,000 paid-up capital
- Two quotas for US\$100,00 - US\$500,000 paid-up capital
- Four quotas for US\$500,000 plus paid-up capital

R. INVESTMENT INCENTIVES

- Corporate tax - 8% on export income, 25% for hotels and 35% for others
- Locational incentive - 25-50% tax rebates
- Tax holidays - indefinite for cocoa farming, 3-10 years depending on sector; 10 years for Free Zones with 8% corporate tax thereafter
- Tariff exemption - 100% duty exemption for production equipment

S. INVESTMENT GUARANTEES

- Constitutional provision
- Investment laws which guarantee 100% transfer of profits, dividend etc.
- MIGA membership

- Investment Promotion

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